view. When applied absolutely unadulterated, it does not act as a quick, destructive poison. There is a gradual loss of functional activity, the rapidity of the loss depending upon the strength of the application. If the time of contact be not too long, perfect recovery may take place; but if it be protracted beyond a certain period, permanent death results. No signs of irritation are produced. It is very evident how this is just what would be expected of a poison exerting no influence but a catalytic prevention of tissue metamorphoses. As these changes lessened, functional activity would die away; and yet, if the dormancy of chemical action continued not too long, the part would awake again to life.

The organization and function of the muscle is so much less complicated and more robust than that of the nerve, that it is very conceivable, indeed a seeming necessity, that any drug acting by checking oxidation must, when taken into the system, affect more profoundly the latter than the former. But is it conceivable that the motor cells of the cord are so much more sensitive and readily affected than the sensory? Is it possible that, supposing the nitrite to act solely in the way spoken of, the motor system would be so much sooner and more profoundly affected than the sensorium?

I think it is conceivable, and it would appear to be in agreement with the well-known fact that in paralysis motion is generally much more affected than sensation.

Such speculation or reasoning as this, however, proves nothing, it simply brings the matter into the sphere of probabilities; and the only conclusion that I can arrive at is that the nitrite of amyl, by virtue of a peculiar chemical power, does check tissue metamorphoses, and it is possible that its physiological properties depend upon this.

PHILADELPHIA, Jan. 28, 1871.

ART. III.—*On the Secondary Traumatic Lesions of Bone, i. e., the Inflammatory Disorders of Bone which result from Injury.* By JOHN A. LIDELL, M.D., of New York.

AN attentive consideration of this subject[1] has led me to adopt the following conclusions, which are now, for the first time, presented for publication in a compendious form.

1. Osteo-myelitis occurs much more frequently than has generally been supposed. This statement obtains in both civil and military practice, and with the spontaneous as well as with the traumatic form of the disease.

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[1] Vide *Surgical Memoirs of the War of the Rebellion*, collected and published by the U. S. Sanitary Commission, vol. i. Hurd & Houghton, New York, 1870.

2. When after amputation, or resection, or compound fracture, or contusion of bone, patients do badly without apparent cause, oftentimes this disease is present, and, unsuspected, leads to disastrous consequences.

3. *Osteo-myelitis* is a much more formidable disorder than *periostitis. Traumatic osteo-myelitis very often destroys life; traumatic periostitis almost never.*

4. *Traumatic ostitis* (*i.e.*, traumatic inflammation of the bone-tissue proper) occurs but very seldom, or perhaps never, as a primary affection. Secondary inflammation of the osseous tissue, however, is often met with when bone is injured.

5. Secondary ostitis, but especially its degenerative and destructive forms, is induced by osteo-myelitis much more frequently than by periostitis.

6. The structural changes which the inflammatory process may occasion in the marrow itself are, *a*, its transformation into new bone (endostosis); *b*, hepatization or carnification (sclerosis) of the medullary tissue; *c*, suppuration or abscess; and *d*, gangrene.

7. Osteo-myelitis may terminate in recovery, *a*, by resolution, and *b*, by metamorphosis of the irritated medullary tissue into new bone. It is probable that inflammation of the marrow very often disappears, *i.e.*, is cured, in each of these two ways.

8. The inflammatory process, when excited in the marrow, *i.e.*, inflammation of the marrow, is very apt to spread to the surrounding bone, to the periosteum, and to the connective tissue and other structures external to that membrane.

9. Secondary ostitis, when induced in this way, may lead to condensation (*sclerosis*) of the bone-tissue, to rarefaction (*osteo-porosis* or *medullization*), to ulceration (*caries*), and to gangrene (*necrosis*). When sclerosis occurs in bone, the inflammatory process is in reality formative in character; but when the other three results are produced, or either of them, it becomes degenerative or destructive, at least so far as the osseous tissue is concerned. Sometimes all of these consequences of ostitis, namely, sclerosis, medullization, caries, and necrosis, are severally shown in different parts of the same bone.

10. When inflammatory irritation is transmitted to the periosteum from the interior of bone, it is apt to excite the deep or osteo-genetic layer of that membrane to fresh activity, and thus lead to the formation of new osseous laminæ (*periostosis*). Occasionally, however, when the irritation is very intense, and the constitutional condition of the subject happens to be bad, *e. g.*, scorbutic, or spanæmic from want of food, or scrofulous, it leads to the formation of pus beneath the periosteum, instead of new bone; but the proliferating layer of the periosteum is generally much less disposed to engage in the purulent transformation than the medullary tissue. Not unfrequently the marrow is found extensively destroyed by suppurative inflammation, without there being any disorder of the periosteum, except

some slight reddening and thickening. Generally, the periosteum does not become spontaneously detached from the underlying bone unless necrosis has occurred. While moderate loosening of this membrane is not unfrequently found in connection with osteo-myelitis, extensive detachment, not due to necrosis, is, according to my experience, very rare.

11. Primary periostitis of traumatic origin but seldom gives rise to much trouble. Some degree of periosteal inflammation, however, is often produced by injury. It generally terminates in cure by resolution, or leads to the formation of new bone. Occasionally, periosteal abscesses of limited dimensions or small size form in consequence of it; and in rare instances destructive results ensue.

12. Necrosis is dry gangrene of bone. The inflammatory is probably the most common form. The ostitis which produces it is generally acute. The circulation of nutrient blood in the affected part of bone suddenly becomes arrested from pressure (compression) exerted by the products of the inflammatory process (exudation and wandering cells) upon the capillary bloodvessels, when effused within the unyielding walls of the Haversian canals. The secondary ostitis which thus produces necrosis pretty certainly has its starting-point in inflammation of the marrow much more frequently than in inflammation of the periosteum.

But necrosis is not unfrequently occasioned directly by violence. In the cases belonging to this category, the circulation of blood and nutrient juices is arrested in the affected part of bone, because the force of the blow or other form of injury has sufficed to smash the Haversian canals, the canaliculi and the lacunæ, to a sufficient extent, without producing any solution of continuity or fracture that is visible to the unaided eye.

Removal of the periosteum or the marrow does not necessarily compromise the vitality of the exposed osseous tissue, *i. e.*, does not necessarily produce necrosis. Under favourable circumstances, each of these structures is replaced by a new outgrowth from the bone itself, having the same nature and composition as the lost part.

13. I have also several times seen a *humid or mephitic gangrene of bone.* It is an affection quite distinct from ordinary necrosis, and is produced by causes of which we have at present but little knowledge. In it the disordered bone is wet, more or less softened or rotted, discoloured, *i. e.*, more or less blackened, and very fetid in smell.

14. The marrow, when inflamed, is more inclined to undergo the purulent transformation, *i. e.*, to suppurate, than any other structure in the whole body.

15. Abscess of the marrow induces pyæmia much more frequently than abscess of the connective tissue, or abscess occurring in any other structure of the body; and the reason of this important fact is, because the pyæmic poison or contagium is absorbed from the marrow much more readily than from other structures, and perhaps also because suppuration in the medul-

lary tissue, is more liable to degenerate into putrid forms than suppuration when occurring in the other tissues.

16. Osteo-myelitis not unfrequently leads to pyarthrosis by causing the inflammatory process to spread to and enter a joint-cavity. Medullitis, when located in the extremities, generally exhibits a marked tendency to travel upwards, *i. e.*, towards the trunk. For this reason the articulations invaded by it are usually found to be those which lie next above the bones wherein it has commenced. The cartilage of incrustation in such cases is generally found to be pierced by a considerable number of minute red holes, which look as if they had been made with a punch. This form of pyarthrosis is, for the most part, not very painful. It comes on silently, and is apt to be overlooked. After it has lasted for some time, the cartilage of incrustation belonging to the next bone may also become pierced with little red holes like those described above, and the inflammatory process then spreads from the joint to the medullary tissue of the next bone. Thus, I have seen inflammation commencing in the medullary canal or tissue of the tibia, by spreading, invade the knee-joint, thereby producing pyarthrosis of the knee, and then spreading still further upwards to the femur, occasion osteo-myelitis of that bone. Thus, also, I have known osteo-myelitis of the femur to induce pyarthrosis of the hip, and afterwards occasion osteo-myelitis of the os innominatum. But medullitis sometimes occasions pyarthrosis in another way, namely, indirectly, by inducing a pyæmic poisoning of the blood, which in turn occasions suppurative inflammation of some joint.

17. When new bone is developed from the marrow, or from the common connective tissue, or from the osteo-genetic layer of the periosteum, it is produced without the exudation of coagulable lymph or the presence of any so-called blastema, by proliferation and direct metamorphosis (transformation) of pre-existing histological structures. So also, when the inflammatory irritation is more intense, the medullary tissue becomes converted into purulent matter (abscess), by direct transformation of the medullary cells into pus-corpuscles, and of the basis or intercellular substance into liquor puris.

18. The connective tissue external to the periosteum (*i. e.*, the common connective or so-called areolar tissue), when irritated or inflamed, generally does not produce new bone, unless there is corresponding irritation of the bone-structures themselves. The presence of some osteal lesion is generally required in order to give the formative process in connective tissue an osteo-genetic direction. Unless the bone is wounded, new osseous growths but seldom or never form amid muscular structures, at least in cases of gunshot injury.

Treatment.—With regard to the treatment required by the secondary traumatic lesions of bone, and especially with regard to the operative procedures required by them, experience and reflection have led me to adopt the following views:—

1. Diffuse osteo-myelitis, whether traumatic or spontaneous in origin, is very perilous, and generally requires that the diseased member should be promptly excised, if the patient's life is to be saved. In such cases, exarticulation is generally preferable to amputation in the continuity, because by the former procedure the medullary tissue is not subjected to injury. If, however, for any cause, amputation is resorted to instead of exarticulation, it should be performed not through the diseased bone itself, but through the sound one next above the seat of the disease, since it is essential to success that all the diseased tissue should be removed by the operation. The operative procedure, whether it be exarticulation or amputation in the continuity, must, as a rule, be resorted to quickly in order to prove successful, because diffuse suppurative medullitis in most cases speedily induces the purulent infection or pyæmia, and thus quickly occasions death.

2. When an abscess, whether superficial or deep-seated, forms in connection with any bone-lesion, it should generally be promptly evacuated by free incision, for thus the cure may be hastened, and at the same time the tendency to pyæmia may be considerably diminished.

3. In treating the chronic localized or circumscribed forms of bone-disease when necrosis occurs, the dead bone should, for the most part, be extracted by operation as soon as it becomes detached, for then longer delay is usually fraught with evil.

4. Chronic abscess of the bones in general, abscess of the diploë, and abscess situated between the skull and dura mater, usually require that their osseous walls should be pierced with a trephine, in order to set the imprisoned matter free.

5. In the chronic cases of bone-disease in general, and especially in those of traumatic origin, the timely extraction of necrosed fragments, the prompt evacuation of matter from all abscesses—from those occurring in the soft parts by incision, and from those occurring in the bone itself by trephining—aided by appropriate constitutional treatment, ordinarily suffice to effect a cure.

6. In some cases belonging to this category, however, when important joints become implicated, or where abscess occurs in the head of such bones as the femur, tibia, and humerus, or where caries or any other form of degenerative or destructive ostitis gets far advanced or widely spread, it generally becomes necessary to cut off the diseased member, in order to save life. In such cases, also, exarticulation is generally preferable to amputation in the continuity, first because it is more philosophical, but mainly because it yields much better results. Reamputation of stumps at joints (exarticulation), for chronic osteo-myelitis, has proved to be a very successful operation.

62 East 12th Street, May 1, 1871.